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CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD COMMENTS ON KEY QUESTIONS FOR AGENCIES (GROUP #3 – CUMULATIVE IMPACTS)

Thank you for the opportunity to offer comments regarding the key questions for cumulative effects (CEs). Recent conceptual, analytical, and technological advances have increased our capability to assess CEs (MacDonald, 2000; Doten et al., 2006; Benda et al., 2007). However, there are still considerable uncertainties, and this is why they are still a significant source of debate in the scientific and regulatory communities.

Despite these uncertainties, it is sometimes necessary to increase the scope of CE analyses when the resource of concern is highly valued or if the risk to the resource is relatively high. Given the potential risk to T/I species, the scope of the CE assessment needs to be more explicit than currently required in the Forest Practice Rule's CE assessment methodology (see Board of Forestry Technical Rule Addendum No. 2 Cumulative Impacts Assessment). In particular, the geographic assessment area needs to be consistent with the resource of concern (i.e., salmon) and with the processes that influence these resources (i.e., sediment, water, and wood regimes). This concept needs to be reinforced during the THP review phase, or made more explicit in the FPR's CE assessment methodology. Guidance for analysis can be improved by developing a CE manual that outlines a technically valid approach to assessing CEs, and helps determine if and how CEs can be mitigated.

Additionally, meaningful CE analyses could be implemented using a tiered approach (MacDonald, 2000), where the FPR-required project scale CE analyses can be nested within a watershed analyses framework (Montgomery et al., 1995). Watershed analyses can be performed jointly by state agencies and stakeholders, can utilize recent advances in science and technology, and can utilize project scale CE analyses as inputs for the watershed scale assessment. The same cooperative approach can be used to implement a focused monitoring program which monitors the implementation and effectiveness of the FPRs, in addition to selected in-channel resources. In turn, the long-term commitment to monitoring and data collection can provide a feedback loop that increases our capabilities to assess and manage CEs.

Key Question #61: To be responsive to the potential for cumulative effects, the spatial scale of applicability of the T/I rules must expand beyond a T/I watershed area to consider T/I rules in those "non-T/I" watershed that flow into a "T/I" watershed. Should cumulative impacts analysis consider upstream areas of planning watersheds that are completely outside the anadromous zone? What is the legal, policy, or science basis for your perspective.

Comments: Yes. The spatial scale of the CE analysis should be dictated by the spatial scale of the processes that control the resource of concern (MacDonald, 2000). For example, detectable management-induced changes in peak flows can occur at scales of up to 10-20 km^2 (i.e., approximately 2500-5000 acres) (MacDonald and Coe, 2007), and modeling studies have suggested that management-induced increases in the mean annual flood can persist in watersheds of up to 150 km^2 (LaMarche and Lettenmaier, 2001). While hydrologic impacts typically decrease in the downstream direction (MacDonald and Coe, 2007), when combined with other factors it may still lead to a significant cumulative impact (Tonina et al., 2008). In the case of coarse sediment (i.e., >2 mm), data from Redwood Creek suggest that sediment slugs still persist after traveling more than 15 km downstream over a 20 year timespan (Madej and Ozaki, 1996).

While we recommend that the scale of analyses should be expanded beyond the anadromous zone, we do recognize that there should be an upper limit to the spatial scale of the watershed assessment area for CE analysis. This is because the ability to assess CEs decreases dramatically with increasing scale due to the effects of in-channel storage, dilution, etc (MacDonald, 2000). The United States Forest Service and Washington State suggests the appropriate spatial scale for analyses is 50-500 km^2 (Ecosystem Analysis at the Watershed Scale, 1995; Washington Forest Practices Board, 1997), and the 2001 "Dunne Report" suggests a spatial scale of 100-200 km^2 (Dunne et al., 2001).

Key Question #62: Is there adequate guidance for cumulative impact assessment and effective cumulative impacts mitigation in the T/I rules or the FPRs in general? What is the legal, policy, or science basis for your perspective?

Comments: The T/I rules state that cumulative watershed effects on anadromous salmonid populations and habitat shall be "considered", and that the plan shall "acknowledge or refute that such effects exist." It does not provide guidance on how this should be done.

The FPR's Cumulative Impact Assessment Checklist has been frequently criticized for the following reasons (Reid, 1998; MacDonald, 2000; Dunne et al., 2001):

- The qualitative nature of assessment;
- Lack of repeatability;
- Lack of documentation;
- Lack of expertise for those conducting analyses;
- Spatial scale of analyses can be arbitrary;
- Analytical shortcomings of assessments often missed by reviewing agencies.

Furthermore, Appendix Technical Rule Addendum #2 has a tendency to deal with each impact in isolation, even when CEs are "where individual impacts are combined to produce an effect

that is greater than any of the individual impacts acting alone." The lack of recognition of process interactions and linkages (i.e., indirect effects) results in piecemeal rather than integrated analysis.

In general, there is limited guidance for effective CE mitigation in the T/I rules or FPRs. For example, similar mitigations are often listed more than once but with slightly different wording [e.g. see 936.9(i) and 936.9(t)(7)(A)] – a situation that can lead to confusion. In general, the reliance solely on text to provide guidance can lead to variability in the implementation and effectiveness of mitigation measures. A different approach has been used by Washington State, which has developed an illustrated "Board Manual" to provide technical guidance for effective rule implementation (http://www.dnr.wa.gov/BusinessPermits/Topics/ForestPracticesRules/Pages/fp_board_manual.aspx).

However, the biggest issue is whether the various cumulative impacts mitigations in the T/I Rules or FPRs are implemented correctly or are effective in preventing CEs. Given that there will still be considerable uncertainty regarding certain elements of the T/I Rules after the TAC literature review, there will be a need for systematic, long-term, and nested watercourse monitoring to ensure that CEs are mitigated effectively. While this task may seem daunting for a single agency, it may be more feasible when implemented in a cooperative fashion by the relevant stakeholders.

Key Question #63: Do the T/I rules or the FPRs in general provide adequate guidance and effective mitigation for addressing cumulative sediment effects associated with roads? What is the legal, policy, or science basis for your perspective?

Comments: In general, no. Many of the Forest Practice Rules pertaining to road erosion are not based on the best available science. For example, it is well known that road surface erosion is typically delivered into the channel network at watercourse crossings (Wemple et al., 1996; Coe, 2006). In the Sierra Nevada, road rocking has been shown to reduce road surface erosion by more than an order of magnitude relative to native surface roads (Coe, 2006). Despite this, there is no clear mention in the T/I Rules or FPRs that road sediment delivery can be substantially reduced by disconnecting road drainage on the crossing approaches and rocking the road surface between these waterbreaks. Additionally, the FPRs treat waterbreak spacing for tractor roads and truck roads the same, despite the fact that truck roads have the ability to generate much more overland flow than tractor roads because of order of magnitude (or greater) differences in saturated hydraulic conductivity (Cafferata, 1983; Coe, 2004) and resultant increases in infiltration excess overland flow. Furthermore, the 3-year maintenance period specified in the T/I Rules is reasonable if roads are no longer used after the maintenance period is over. However, many of these roads are used for administrative purposes (thinning; herbicide application; etc) or by the public, and there is no mechanism in the FPRs to ensure that proper road drainage is maintained beyond the maintenance period. Although out of the BOF's control, this is a major shortcoming of the Forest Practice Act (see FPA 4562.9), as roads are relatively permanent features that can alter drainage patterns, convey runoff, and deliver sediment to watercourses well beyond the life of a THP.

Key Question #64: Do the T/I rules or the FPRs in general provide adequate guidance and effective mitigation for addressing cumulative sediment effects as related to rate of harvest, which is related to watershed resiliency to stressing storms? What is the legal, policy, or science basis for your perspective?

Comments: The T/I rules and/or FPRs do not provide adequate guidance for addressing harvest rate and cumulative sediment effects, and do not address potentially important cause-and-effect mechanisms. For instance the T/I rules state that timber operations should "result in no substantial increases in peak flows or large flood frequency" [see 936.9(a)(7)], but does not provide guidance on what constitutes a "substantial" increase or which peak flows or floods are of importance. The Appendix Technical Rule Addendum #2 states that CEs caused by management induced peak flow increases are difficult to anticipate, that the magnitude of the management-induced peak flow increases is relatively small when compared to the natural peak flows from medium and large storms. Despite this statement, the general tendency is for timber harvest to increase the magnitude of peak flows (Austin, 1999; Moore and Wondzell, 2005), increase stream competence, and potentially increase bedload and suspended sediment transport (Heede, 1991; Troendle and Olsen, 1993; Lewis et al., 2001). This might be especially true in low order channels (i.e., Class III watercourses), which are closely coupled to harvested hillslopes, are typically transport limited (Montgomery and Buffington, 1997), and might become deficient in LWD-induced channel roughness features due to the lack of overstory retention standards for class III watercourses. This and other cause-and-effect mechanisms and process linkages are not considered in the T/I rules and/or FPRs.

Key Question #65: Should the T/I rules or the FPRs in general develop a disturbance index reflecting cumulative sediment effects and a watershed's resiliency to stressing storms? What is the legal, policy, or science basis for your perspective?

Comments: The likelihood of management-induced erosion reaching a stream channel is dependent on the sediment transport process (e.g. sheetwash, gully erosion, mass wasting, etc.), proximity of disturbance to the stream channel, flowpath characteristics, sediment particle size, level of disturbance, and the magnitude of runoff and erosion events (MacDonald and Coe, 2007). These processes can vary tremendously within and between watersheds. As such, disturbance indices only have utility as a relative indicator of cumulative sediment impacts. Furthermore, using lumped disturbance indices (e.g. equivalent roaded area or equivalent clearcut area) can be problematic in regulatory applications because they do not identify or quantify sediment sources and lack the process-based analyses needed to guide regulators and resource managers (MacDonald and Coe, 2007). If disturbance indices are used, they should be spatially explicit (e.g., percent of harvest in extreme erosion hazard areas), process explicit (i.e., does the index reflect changes in flow, sediment, or wood loading?), and should consider hillslope-channel linkages (e.g., density of roads connected to streams; road crossing density). Disturbance indices have the potential to be used as a stratification tool for selecting sites for in-channel monitoring. The CVRWQCB uses a disturbance index in this manner for their Timber Harvest Waiver (see Resolution No. R5-2005-0052; Attachment B.III.C).

Key Question #70: Should timber harvest proposed in non-T/I planning watersheds that drain to T/I watersheds explicitly assess the potential for cumulative impacts that could occur in downstream areas as a result of proposed timber operations? Do the existing T/I rules or other FPR sections adequately require this assessment?

Comments: Yes. See comments for key question #61.

Key Question #71: Is there adequate guidance for watershed-wide analysis in the T/I rules or the FPRs in general?

Comments: No. The FPRs requires a quasi-watershed analysis through cumulative impacts assessment and requires a "Watershed Assessment" for the Sustained Yield Plan process. Neither of these assessments is the integrated, process-based, or comprehensive analyses needed to inform land managers or regulators. Montgomery et al. (1995) suggest a conceptual framework on how to conduct watershed analyses, and Washington State has a Watershed Analyses Manual based on this framework (WFPB, 2007). Also, emerging technology has made the task of watershed analyses more cost-effective (e.g. see NetMap; Benda et al., 2007).

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